NASA Research Park: Briefing to NASA Symposium on Resilience and Adaptation to Climate Change Risks

Executive Summary

- **NASA Research Park (NRP) is located on property at NASA Ames Research Center in California's Silicon Valley**
  - In 1994 NASA took over ownership of the 1300-acre property of the former Naval Air Station Moffett Field adjacent to the original 500-acre NASA campus
  - NASA has developed the property into the NASA Research Park to create a world-class, shared-use R&D campus for government, academia, non-profits and industry
  - Partnership with Mountain View and Sunnyvale (local cities) from the beginning

- **The NRP brings academia, industry and NASA together into a collaborative and profitable partnership to advance the NASA mission**
  - 70 onsite partners (including 15 universities and over 45 companies)
  - Developed culture of collaboration
  - Proven business management and processes
  - Environmental entitlement completed approx 5 million sf new construction
  - Large-scale leases--Google (42 acres 1.2M sf) and University Associates (72 acres 3M sf)
    - Both organizations planning to build green campuses
  - Overall emphasis on R&D and STEM education, with major focus on clean technology companies

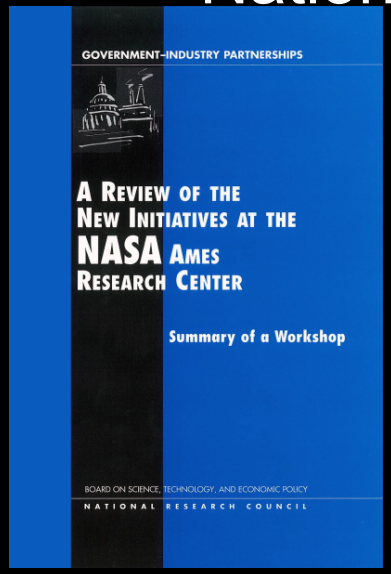
- **Internal and external reviews indicate that the NRP will have direct programmatic and financial benefits for NASA and the nation**
  - 2003 U.S. Government "Best Innovative Policy" national award
  - National Research Council Review, "new model of industry-government partnerships."
  - National Academy of Sciences "NRP a NASA and National Asset" Paper Presentation 2008
  - National Research Council "Understanding Research, Science and Technology Parks: Global Best Practices" 2009

NRP Collaboration Strengthens Key Partnerships

NASA Research Park: 2020 Campus Plan

- NASA Research Park is uniquely positioned as a nourishing and dynamic environment for cutting-edge research and education.
- Through this NRP initiative, NASA Ames is creating:
  - A world-class shared-use R&D and education campus for industry, academia, non-profits, and government;
  - A center for innovation and entrepreneurship;
  - A unique community of scientists, engineers, students and educators with a shared mission.
  - As a physical place, NRP fosters both informal and formal interactions through careful master planning and site planning of streets, sidewalks and public spaces as well as careful selection of tenants. It is widely acknowledged that innovation depends on bringing multiple disciplines together to engage in collaborative projects that often yield unpredictable, but highly productive results.
  - Located in the heart of Silicon Valley, NRP draws upon a deep pool of well-respected researchers both at NASA Ames and in the regional community of colleges and universities, technology-oriented nonprofits and high-tech R&D companies
    - Improves NASA performance by onsite R&D collaborations
    - Actively promotes innovation
    - Enhances human capital development

National Research Council Reports on NRP



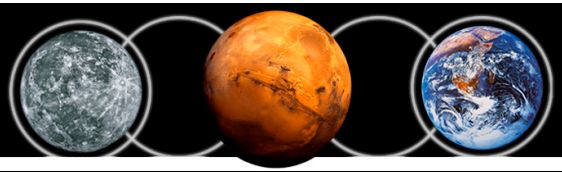
A Review of the New initiatives at the NASA Ames Research Center
NRC (2001)

Understanding Research, Science and Technology Parks
NRC (2009)

- NRP represented a "new model for Industry-Government Partnerships" in its 2001 report
- NRP as having "made great progress, exceeding expectations and enacting NASA plans with remarkable effectiveness."
- NRP is different from traditional science and technology parks in the following ways:
  - Traditional science and technology parks are oriented toward transferring technology and knowledge out to the external community;
  - NRP provides a two-direction channel focused on (i) traditional NASA technology commercialization "out" to industry, and (ii) technology infusion "into" NASA by gaining access to knowledge and leading-edge technology from the external community;
  - NRP serves as NASA access to Silicon Valley and California's research universities.

Ames Research Center

in Silicon Valley



Ames Research Center

in Silicon Valley

NASA Research Park: Emphasis on Developing Sustainable Companies

Executive Summary

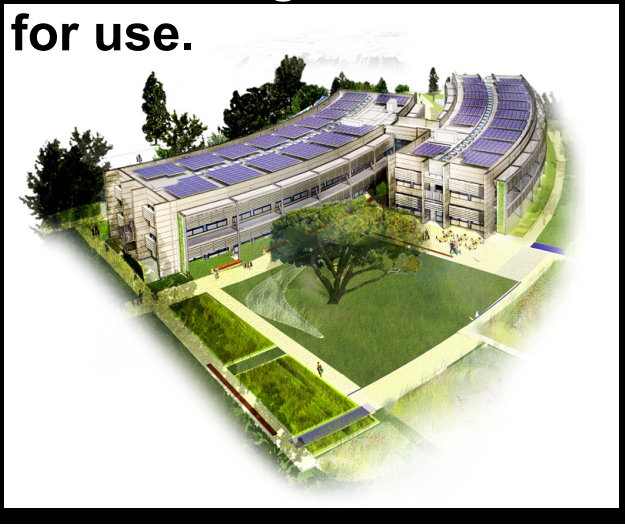
Current NASA Research Park 15-year Plan

- **Continue to bring in partners to use land, Moffett Federal Airfield and the Hangars surrounding the Airfield in a secure federal R&D context and in the context of the NRP**
  - Allows for remarkable potential synergy for the development of green technologies, airships and green aircraft, and operations
  - A unique infrastructure for airship R&D, high-altitude wind power generation R&D
- **A Center of Excellence for Sustainable Technologies (Clean Tech)**
  - Utilize unique system of hangars, eastside land and Airfield in the NRP to pursue critical national need with NRP industry partners
    - Hangars 2 & 3 and adjacent land initially then Hangar 1 when renovated
- **Many NRP partners are engaged in sustainable technologies, including fuel cells, airships, high-altitude wind power generation, land based wind power generation, personal rapid transit systems, UAVs, electric cars**
- **Complement NASA Aeronautics emphasis on green aviation and green technology (including NASA project OMEGA)**
- **NASA Ames opening in 2011 new Platinum LEEDS most energy efficient building in the federal government**

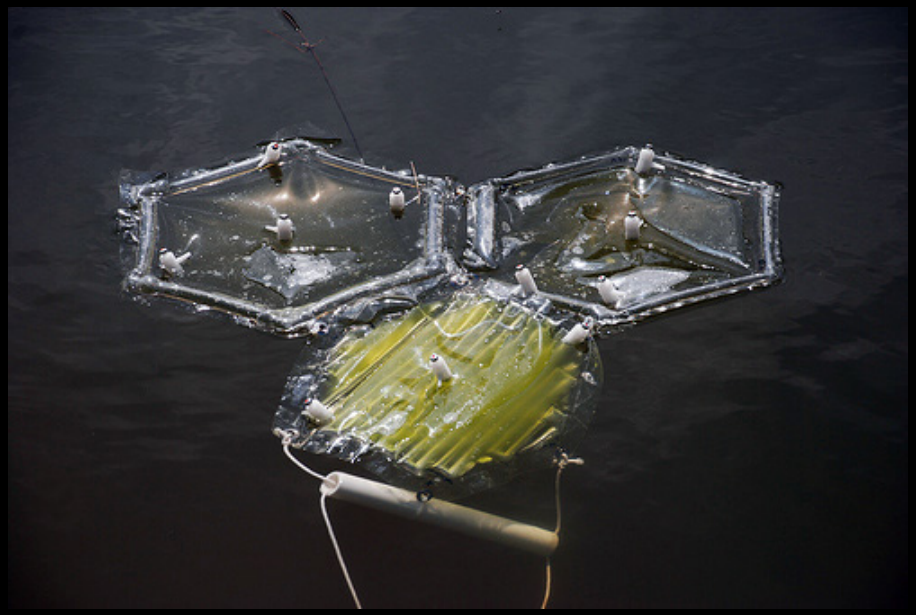
Ames Research Center
in Silicon Valley

Most Energy-Efficient Federal Building

- LEED Platinum
- Uses 90 percent less water than a conventional building by recycling its own water and using rainwater for irrigation of native plants.
- Uses solar panels, fuel cells, and 72 geothermal wells which take advantage of the earth's temperature for cooling and heating.
- Utilizes a NASA-developed computer system that will measure wind velocity using sensors developed for space to determine if and when to open windows for ventilation; get "Web" weather forecasts to optimize energy use in real time; and turn on air-conditioning in conference rooms only when they are scheduled for use.
- Net zero energy use –
- a near zero carbon footprint.



OMEGA: Algae Bioreactor as a Sustainable Energy Source



Supported by NASA Aeronautics Research Mission Directorate and the California Energy Commission:

- The project's goal is to demonstrate the feasibility and scalability of OMEGA (Offshore Membrane Enclosure for Growing Algae) with respect to the biology, engineering, and economics, and to insure that its environmental impact remains beneficial at the large scale needed to replace our dependence on fossil fuels. The hope is that, based on this demonstration, people worldwide will realize the potential of OMEGA, and adapt and develop versions of OMEGA for the good of all
- OMEGA website: *http://www.nasa.gov/centers/ames/research/OMEGA/index.html*
- The Green Space Initiative: *http://www.nasa.gov/centers/ames/GreenSpace/*

University Associates - Silicon Valley LLC

- **A partnership with the University of California Santa Cruz and Foothill DeAnza Community College District**

  Other universities considering joining
- **A major step toward NASA's vision of creating a world class center for research, education, innovation and related commercial development**
- **Lease total 77 acres and up to 3 million sf of new labs, classrooms and housing – "green" Development**
- **UCSC Silicon Valley Center operating in Bldg 19 for 3 years**

  Development of new technologies emerging from the convergence of bio-info-nano scientific research

  - Autonomous systems and advanced robotics
  - Highly efficient and renewable energy sources
  - Technologies for long term sustainability of human life
  - Educating and developing the work force of the future
  - Managing innovation in the emerging world
  - Associated academic public policy centers

Existing Sustainable NRP Companies

- **Bloom Energy**
- **E-Green Technologies**
- **Airship Ventures**
- **Airship Earth and Magenn Power**
- **UAV Collaborative**
- **Green Transportation**
  - –Tesla Motors
  - –Kleenspeed
  - –Unimodal

- **Pending new lease**
  - –Russo Industries

NASA Aeronautics and Space Administration

BLOOMBOX

Bringing NASA Technology Down to Earth

KR Sridhar
Principal, Co-founder and
Chief Executive Officer
at Bloom Energy

NASA Research Park
Exploration Lecture Series

January 18, 2011
7:00 - 9:00PM
NASA Ames Conference Center
(NACC) Building 3

Free and open to the public

For more information, visit:
http://researchpark.arc.nasa.gov/

http://www.nasa.gov/

Bloom Energy Corporation: Breakthrough Fuel Cell Technology

Bloomenergy™

- **Bloom Energy can trace its roots to work performed at the University of Arizona as part of the NASA Mars space program. Dr. KR Sridhar and his team were charged with creating a technology that could sustain life on Mars. They built a device capable of producing air and fuel from electricity, and/or electricity from air and fuel.**
- **Bloom Energy reports that its NRP location has provided many benefits including:**
  - Ability to maintain and build close relationships with senior NASA staff, opening the door for continued collaborative partnerships;
  - Proximity to the scientific, engineering, and business talent;
  - A strategic physical location in the center of Silicon Valley;
  - Access to networks of entrepreneurial companies and venture capitalists;
  - Enhanced security through staffed gates at NASA Parkway and Ellis Street.
- **In 2005, Bloom Energy expanded to a new corporate headquarters and manufacturing facility in Sunnyvale, a short five-minute drive from NRP.**
- **Since its founding in 2002 with a small technical team, Bloom Energy has grown to a workforce of over 700 people both locally and at its facility in India, employing a diverse and talented team of researchers, engineers, and business people.**

E-Green Technologies

E-Green Technologies is dedicated to excellence in the development and manufacturing of low-altitude, mid-altitude and high-altitude airships. Company is dedicated to delivering superior technology and effective solutions to a broad range of markets, including military, government and private sectors.

Applications include:

- Defense and Homeland Security
- Telecommunications
- Natural Resources
- Agriculture Assessments
- Forest Fire Monitoring
- Advertising

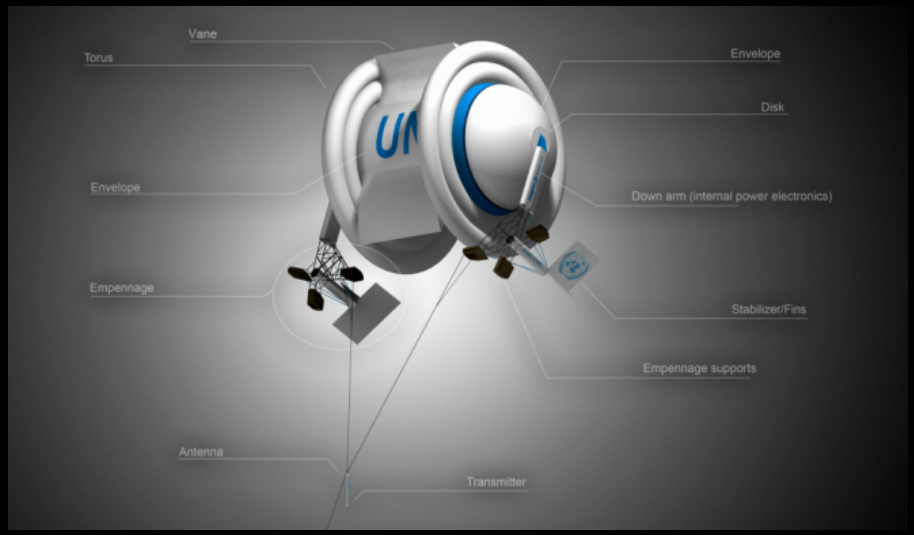
Prototype 125-ft Bullet Airship

Bullet Class 580 Airship Test Inflation

Airship Ventures: Promotes Regional Tourism

- One of the more visible promotional opportunities serving the entertainment, tourism and research markets
- As the nation's first commercial passenger airship service in over 70 years, this "lighter than air" airship has been profiled repeatedly in regional and national media
- This unique commercial venture offers a new perspective on the planet, with "flightseeing" destinations in the South Bay, San Francisco, Monterey Bay, Los Angeles and San Diego.
- The 246-foot-long Zeppelin NT is the largest airship flying in the United States, carrying up to twelve passengers at a time. It is available for special events and corporate rental.
- Through its partnership with Airship Ventures, NASA not only supports the regional tourism infrastructure but also provides other direct benefits to the Agency. The firm has restored airship use of historic Hangar 2, originally constructed as a Moffett Field airdock in 1943, and re-used historic Building 20, the former Bachelor Officer Quarters.
- Airship Ventures and NASA have identified over 50 potential collaborative projects including using the airship as a platform for airborne science and in disaster response scenarios.
- The airship has already conducted a research project with NASA and SETI program in support of the South Bay Salt Ponds reclamation engineering, which garnered national media coverage.

Airship Earth and Magenn Power: Infrastructure for Emergency Response



The MARS 30X, a wind powered aerostat generator developed by Magenn Power, rotates about a horizontal axis in response to the wind, generating electrical energy which is transferred down a tether to the ground. The 30X deploys at 1,000 feet where the wind speed generally doubles, increasing the potential wind power four fold. In partnership with Magenn, Airship Earth is designing antenna and sensor systems as powered aerostat rotor payloads.

- **Airship Earth, a new media production, technology and telecommunications group.**
- **Central focus is building highly interactive, ultra-scale visualization display systems and support networks. The displays and associated programs are being developed to acquire, compress, stream, synchronize, fuse and visualize multidimensional/multivariate datasets used in emergency response, education and entertainment.**
- **Near-term goals include developing more powerful and intuitive tools to visualize and fuse data linked to cross-platform communications systems, through interactive displays that are referred to as Common Operating Pictures, which serve "Communities of Trust" involved with emergency response.**
- **The display systems will provide Incident Commanders and First Responders with ever more effective ways of exploring, analyzing and processing massive and complex data and converting data into "actionable intelligence" and coordinated, coherent response.**
- **Collaborating with Carnegie Mellon Silicon Valley, also based at NRP, Geodan, Geoinformatics specialists based in the Netherlands, ESRI, Microsoft and researchers at NASA Ames Research Center in this effort.**
- **Entered into a Teaming Agreement with Magenn Power to co-develop lighter-than-air, wind powered aerostats that can provide emergency power in disaster areas. Airship Earth's objective in teaming with Magenn is to develop rapidly deployable emergency power generation systems. Additionally antenna and surveillance payloads on the aerostats are being developed by Airship Earth to restore cellular and radio communication and provide high resolution, continuous surveillance over landscapes impacted by natural and manmade disasters.**

Russo Industries USA

To develop and commercialize a revolutionary, environmentally superior wind turbine and related slow-speed electric generator.

The Windcrank

Turbine operates at 1mph wind speed and faster. Units are stackable and deployable in 3 towers of 10 units (30 units total) for every one large rotary turbine blade.

Advantages of the design

- Exceptionally high torque
- Two power take-offs
- Very low avian (bird) and bat mortality
- Significantly reduced noise and vibration
- Stackable applications
- Long service life (minimum of 20 years)
- High stability
- Slow speed
- Low cost

UAV Collaborative: Using Drones to Aid Rescuers

- The nonprofit UAV Collaborative has been based in NRP since 2004 and boasts San Jose State University, Honeywell International, Cirrus Digital Systems, Xtreme Aerial Concepts, MLB Company, Empirical Systems Aerospace and Lockheed Martin among its partners.
- Fuel efficient, reasonably priced unmanned aerial vehicles (UAVs) also known as “drones”, have the potential to stay aloft for significantly longer time periods than piloted craft.
- Low altitude UAVs flying under 5000 ft. have tremendous potential for effective emergency response and disaster assistance when multiple craft in the sky stream data 24 hours a day, aiding the success of challenging missions such as atmospheric sampling, fire fighting and urgent search-and-rescue operations.
- By showcasing and advancing NASA-developed technologies, the UAV Collaborative provides tangible benefits to other federal and state agencies, including the National Forest Service for which UAVs can collect fire-related thermal imagery during a major wildfire event to help improve real-time information.

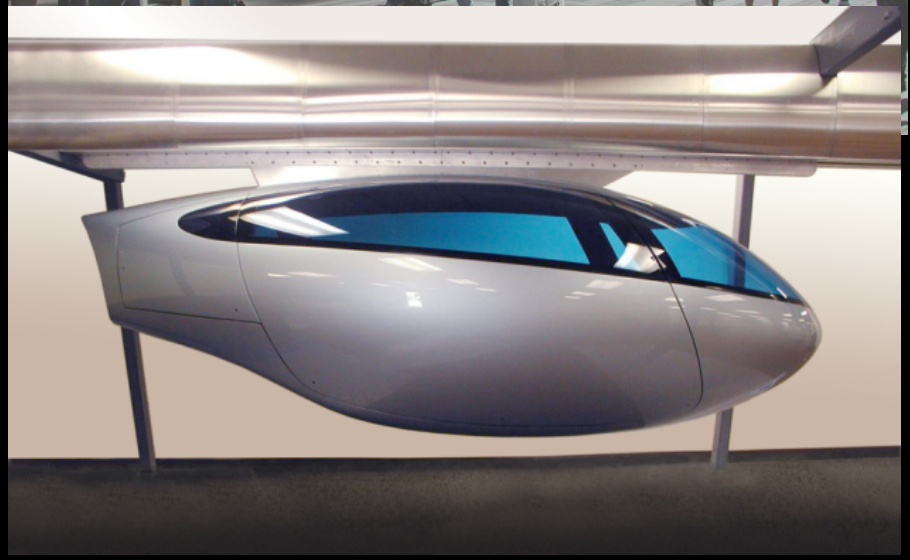
Green Transportation

- **Tesla Motors (still testing roadster and soon another less expensive model)**
  - –use of Airfield for car tests
- **Kleenspeed (will build $20k electric car)**
  - –Initially established to win LeMans race with an all-electric race car
  - –Already setting new electric car speed records at Laguna Seca Raceway
  - –office and R&D in NRP, now planning new electric car
    - › planned to cost less than $20k
  - –use of Airfield for electric car testing
- **Skytran (personal rapid transit)**
  - –Currently in NRP Historic District Office (Bldg 14)
  - –Pursuing grant proposal to build 500ft test maglev test track near Hangar 3 on Eastside of Airfield

KleenSpeed Technologies Inc.: Scalable Electric Propulsion Systems

- **KleenSpeed Technologies, Inc. was founded in November 2007 to develop technology, products and systems for the rapidly emerging electric vehicle industry:**
  - –A partner at NRP since 2008;
  - –KleenSpeed uses racing cars converted to total electric power utilizing KleenSpeed systems;
  - –Vehicles are a laboratory and test bench to develop and test products;
  - –KleenSpeed brings state-of-the-art technologies to a range of other consumer and industrial vehicles.
  - –Uses Airfield tarmac to test electric vehicles
  - –Plans to begin manufacturing a $20k electric car at NUMMI

SkyTran: Maglev Integrated Mobility



SkyTran™ is a next generation high-speed transportation system that will revolutionize mobility. The prototype is being developed at NRP:

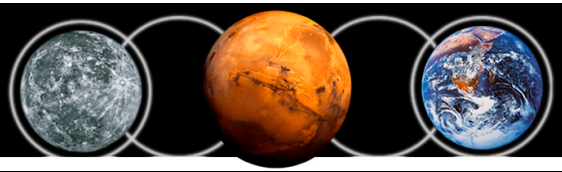
- The SkyTran™ system uses small vehicles running on elevated, magnetically levitated guideways. This enables speeds up to 150 mph and distinguishes it from first-generation wheeled Personal Rapid Transit (PRT) systems that are limited to average speeds of 30 mph;
- The vehicles are lightweight, personal compartments that can transport up to three passengers;
- Using intelligent control system software, a SkyTran™

MIM system will run nonstop point-to-point service without interrupting the flow of traffic;

- Capacity of the system is 14,000 people per hour, both locally and regionally;
- SkyTran™ can serve as a feeder system to other transit systems and high-speed rail;
- The developers of SkyTran™ will collaborate with NASA on the use of NASA control software, prognostic tools and human factors techniques to develop autonomous vehicle control that provides safe and reliable operation of the SkyTran™ system.

Summary Clean Tech

- The NRP focus on clean tech is accelerating these new companies development
- The opportunity with hundreds of grad students onsite in the many NRP partner universities programs allows for easy hiring for these companies as they expand
- This systemic approach to the pursuit of the establishment of a “green economy” is developing
- From technology ideas, to start-up companies, to collaborations with other industry, university and federal lab organizations, to hiring of the many students is unique
- The opportunities for use of clean tech is expanding into disaster assistance, aerial observation for earth sciences, safer ways of assessing disaster conditions
- The opportunity for STEM inspiration for a new variety of careers is also enhanced by these new clean tech companies



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National Disaster Resiliency Center

- **Leaders believe to respond to the challenges of disasters a state of the art Disaster Resiliency Center (DRC) should be located in NASA Research Park**
  - NRP home to several partners providing services and products to the emergency management community, multiple universities pursuing R&D and a regionally recognized disaster education and training center
  - NRP CMU, Foothill-DeAnza, UAV Collaborative, Airship Earth
  - FEMA Warehouse
- **Integrating these existing operations the DRC has three focus areas designed to improve preparedness, training, response and recovery efforts:**
  - Disaster Resilience and Response Hub
    - A centralized and protected location for the staging, logistics, management and coordination of resources in the event of a disaster
  - Applied Research and Technology Laboratory
    - To develop, deploy, test and validate the tools and systems focused on capabilities that Incident Commanders, EOC directors, first responders and the citizens and business with our communities need to more effectively undertake disaster response and recovery operations
  - Advanced Emergency Response Education and Training Center
    - Developing and delivering advanced education and training programs supporting national and regional efforts for emergency and medical personnel in advance of their need
- **DRC Leadership led by Steve Jordan and retired General Peter Gravett**
  - Coordinated through funded DHS grant by Joint Venture Silicon Valley CEO Dr. Russ Hancock
- **Silicon Valley/State Partners:**
  - Google, Lockheed Martin Space Systems, Industrial Emergency Council, Accenture, California Emergency Management Agency, Applied Materials, Juniper Networks (all attended first two meetings)
- **DRC will provide a collaborative public-private hub for coordinated regional, state and national disaster response while developing the model programs and technologies for widespread deployment**
  - **Requires use of Airfield, Emergency Operations Center, Hangars and land**

Summary

NASA Research Park

- •Establishes a new world-class R&D and education campus for the nation
- •Leverages NASA resources for greater mission benefit
- •Enhances scientific research, technology advancement and transfer of research knowledge
- •Pursues NASA's education and outreach goals
- •Provides workforce development for high-tech careers
- •Increases public involvement and understanding of science technology and exploration